DAG'02 Results: Benefits & Feasibility

Paul U. Lee, San Jose State Foundation at NASA Ames

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Ames' DAG'02 Experiment

- 4 days of data collection; 3 runs per day
- 80-100 planes in each scenario
- Approx. 40 arrivals to Bambe meter-fix
  - 7 of the arrivals flown as single-piloted planes
  - Remaining planes flown from multi-aircraft simulator stations

- 4 Center sector controllers
  - 3 High Altitude Sectors (Amarillo, Wichita Falls, and Ardmore)
  - 1 Low Altitude Sector (Bowie)
- 1 TRACON controller

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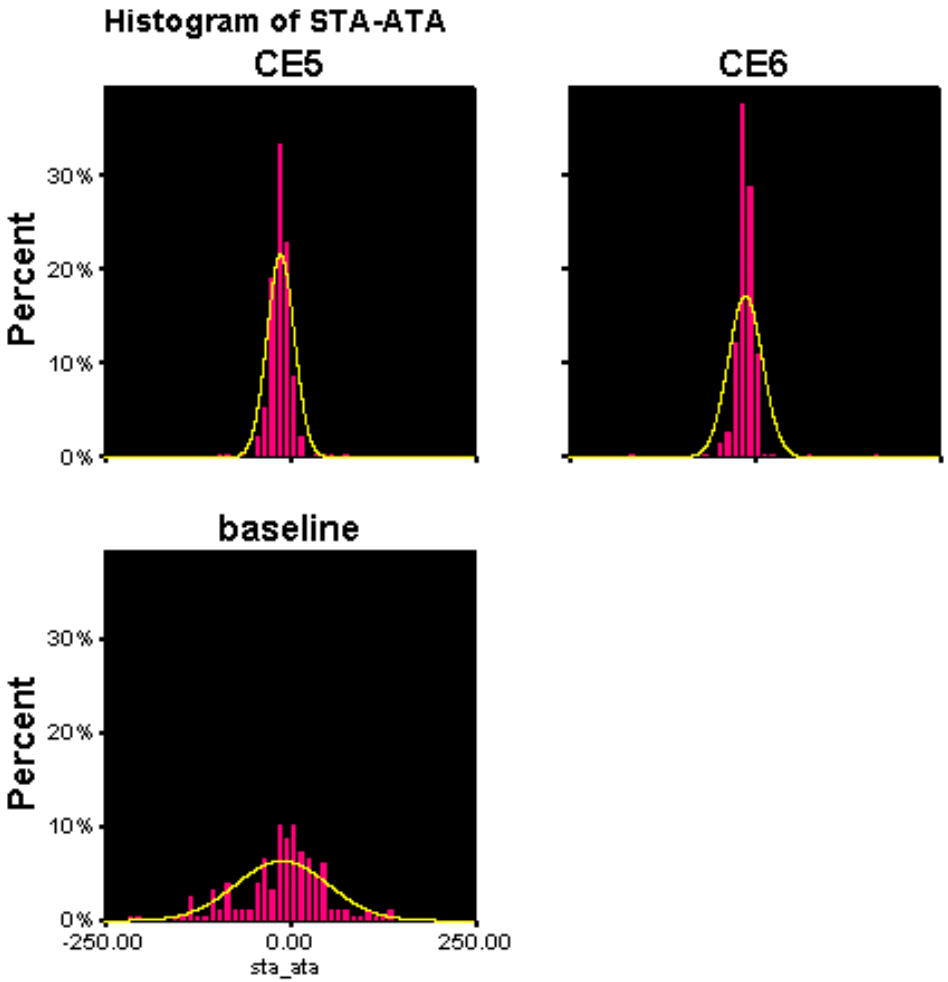
Predictability: STA - ATA



Mean of STA-ATA is similar between condition, BUT...

Variability of STA-ATA greater for Baseline

Meter fix crossing time is more predictable with trajectory-based metering (i.e. CE-5 & CE-6)

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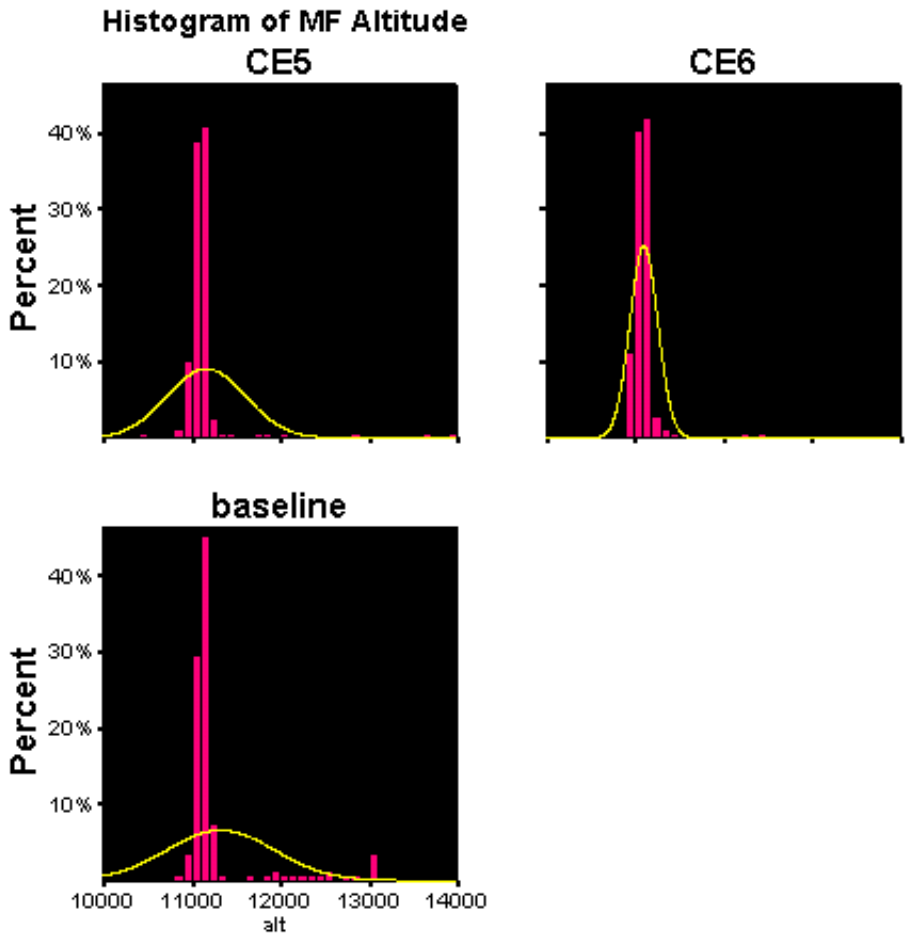
Crossing Restrictions: MF Altitude



- Mean of Meter Fix Altitude is similar between condition, BUT...
- Variability of MF Altitude
  - Baseline > CE-5 > CE-6
- Greater variability due to “stacking” the planes at the MF fix to insure separations
- Meter fix crossing restriction is best met with CE-6

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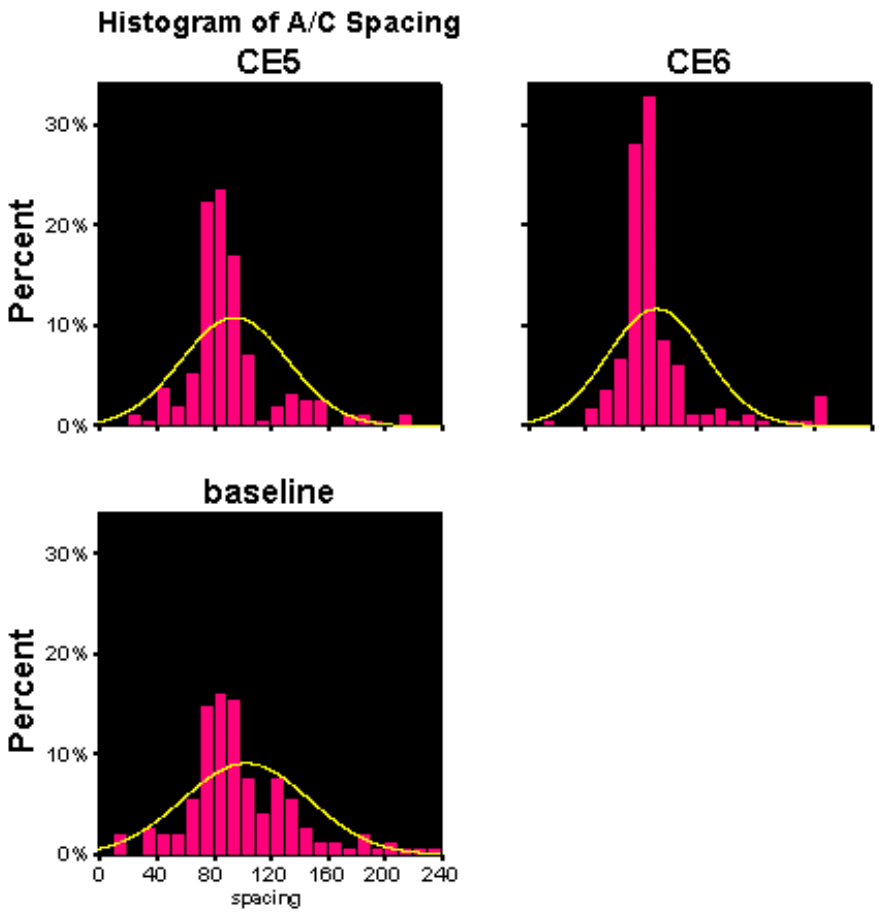
Flow Consistency: Spacing between Aircraft



- Spacing = Time difference b/w two consecutive A/Cs
- Average spacing
  - Baseline > CE-5 > CE-6
- Spacing variability greater for Baseline
- Trajectory-based metering (i.e. CE-5 & CE-6) provides more consistent spacing (i.e. better flow) between aircraft.

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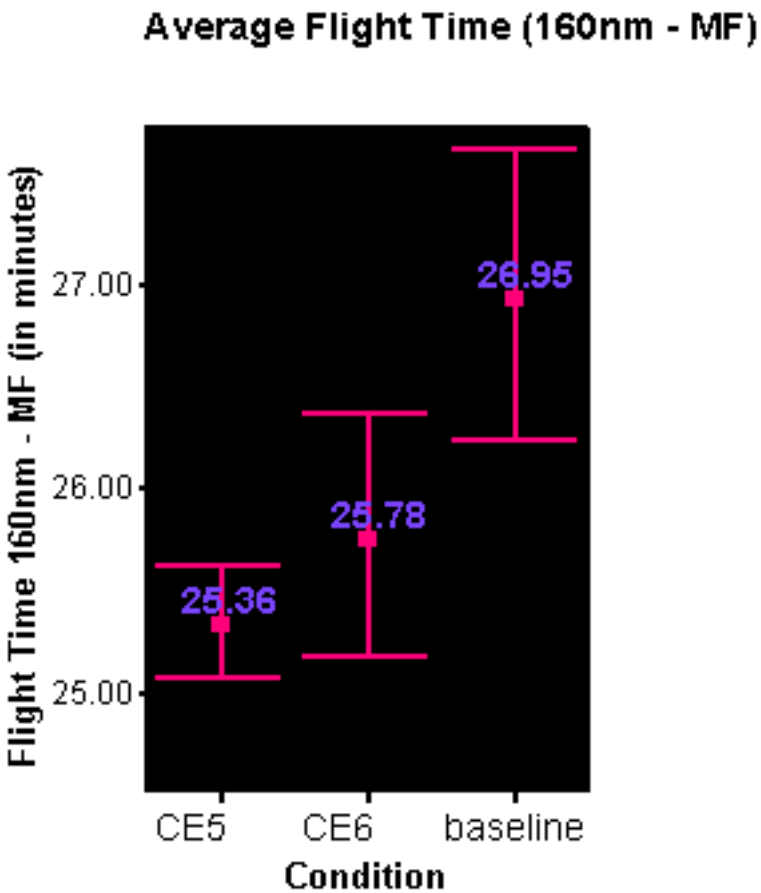
Delay: Average Flight Time



- Average Flight Time from the Freeze Horizon to the Meter Fix
  - Longer flight time for the Baseline by 1 minute
- Average Flight Time is reduced for CE-5 & CE-6, suggesting shorter overall delays.

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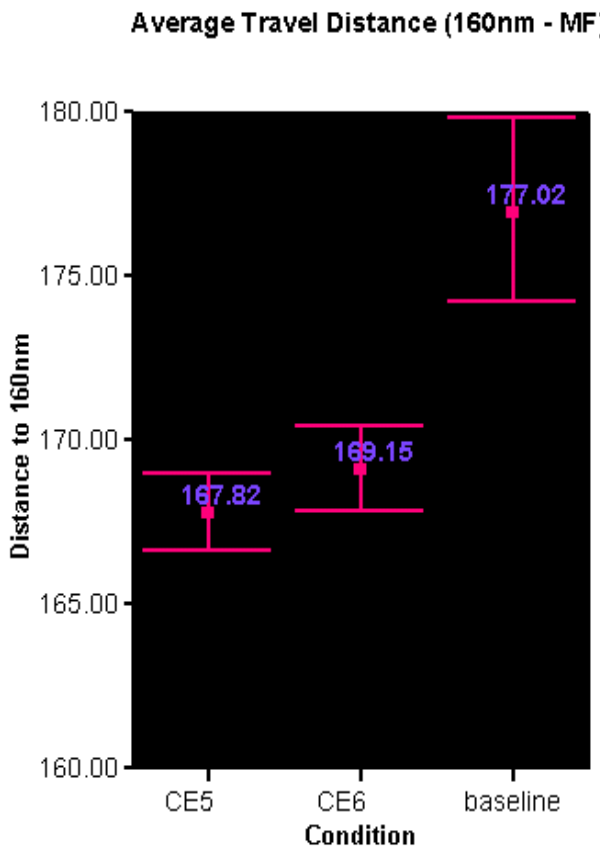
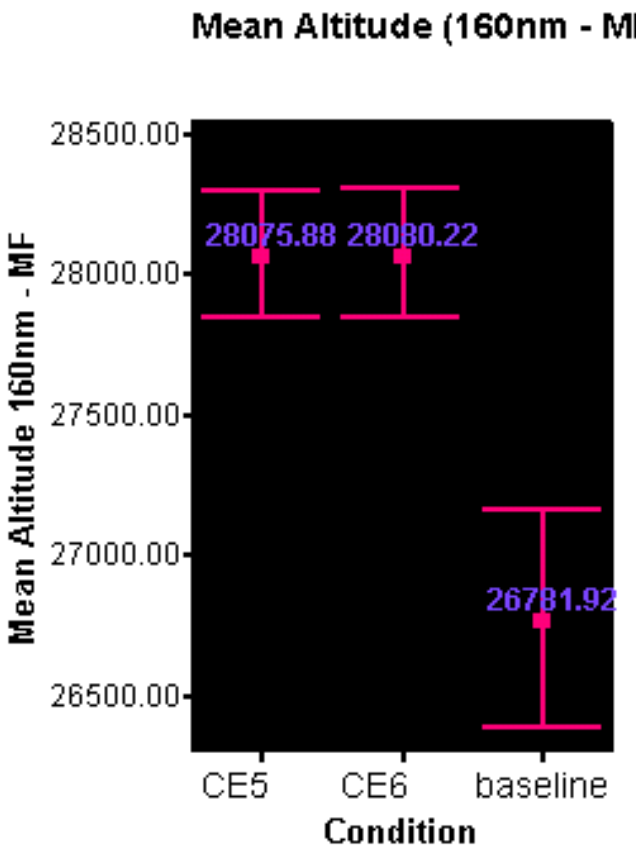
Efficiency: Distance & Altitude





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Efficiency: Distance & Altitude

- Average distance traveled by each aircraft is approx. 10 nm less over 160 nm in CE-5 & CE-6.
- Average altitude from freeze horizon to MF is approx. 1300 ft higher in CE-5 & CE-6

- Higher altitude + shorter distance => better fuel efficiency
  - Trajectory-oriented metering (CE-5 & CE-6) may reduce fuel consumption

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Safety: Separation Violations

Number of Violations / Run

	TRACON	Low Altitude	High Altitude
CE-5/CE-11	2.2	0.6	0.8
CE-6/CE-11	2.25	0	0.75
Baseline (eTMA)	2.5	0.75	1.75

- Trajectory-based metering (CE-5 & CE-6) reduces the number of separation violations in the High Altitude sectors
- Fewer violations in the Low Altitude sector under CE-6 than CE-5 (free flight) or the Baseline
- No difference in TRACON between conditions

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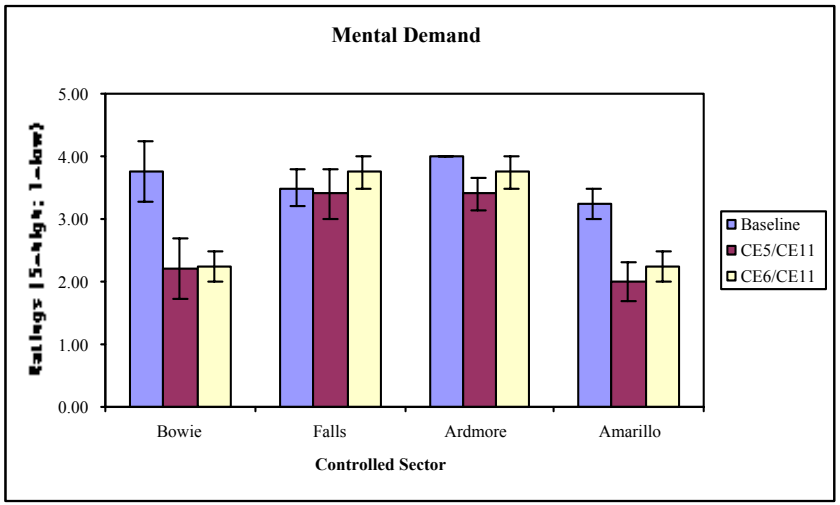
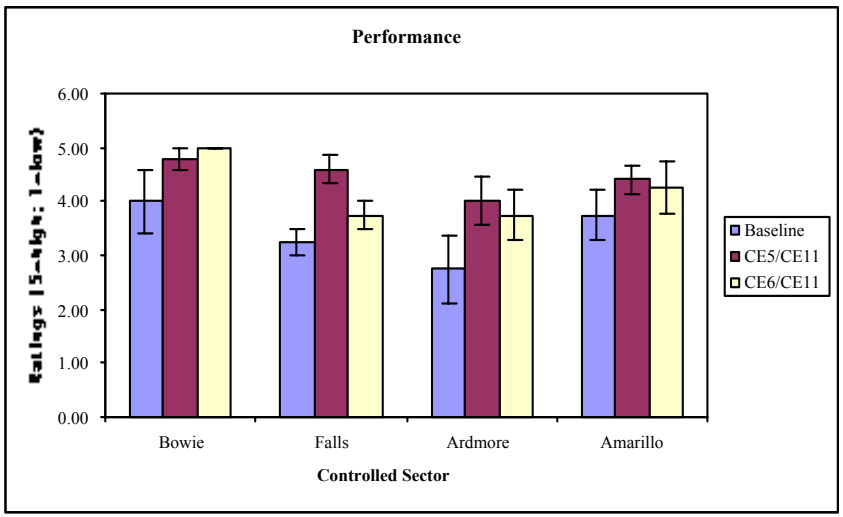
Workload: ATC Ratings



- Mental Demand less in CE-5 & CE-6, especially in the Low Altitude sector (Bowie)
- Performance higher in CE-5 & CE-6



- Greatest workload benefit in the Low Altitude sector
- Benefit likely due to better traffic flow under trajectory-oriented metering

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Summary

- Trajectory-based metering (CE-5 & CE-6) suggests many benefits, including:
  - More predictable meter fix arrival time (STA-ATA)
  - Better conformance to the MF altitude
  - More consistent spacing between aircraft
  - Less delay (less average flight time)
  - Lower fuel consumption (less distance flown + higher mean altitude + shorter flight time)
- Benefits gained without a compromise to safety or ATC workload:
  - Fewer separation violations
  - Lower workload in the Low Altitude sector (Bowie)

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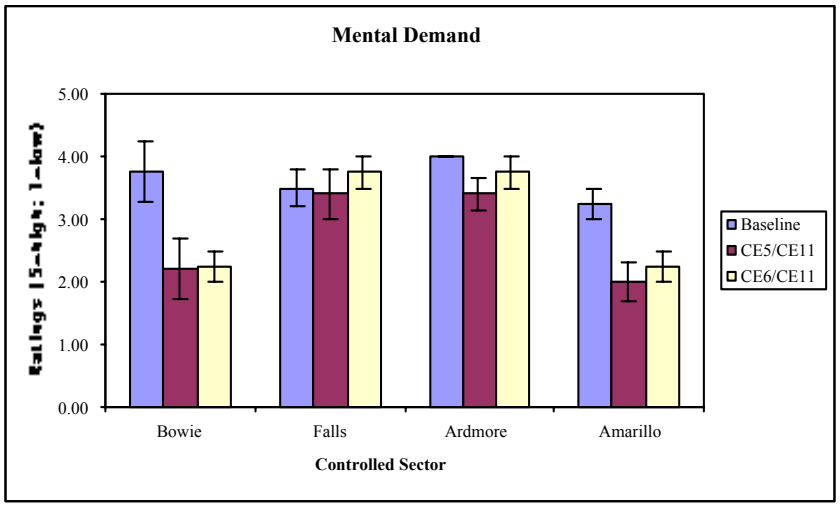
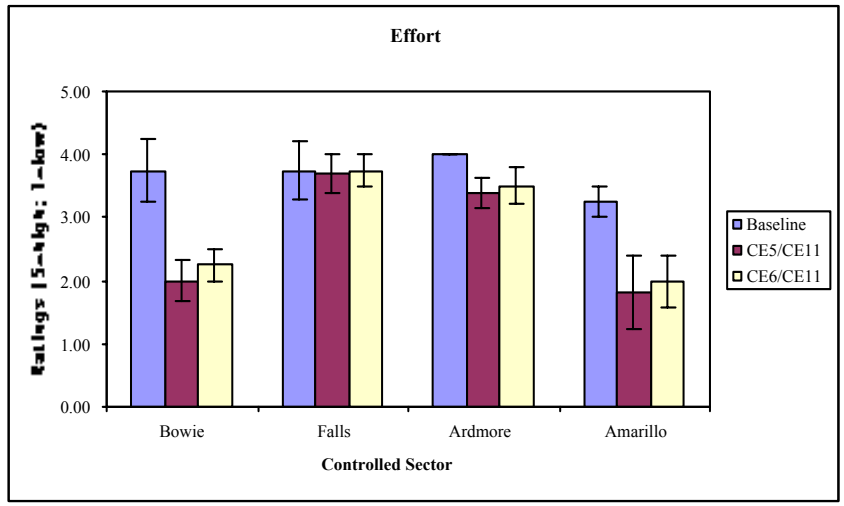
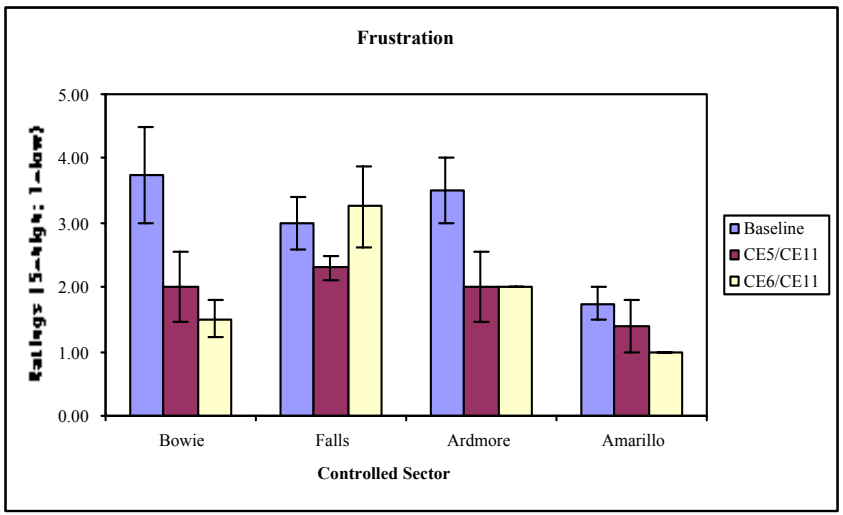
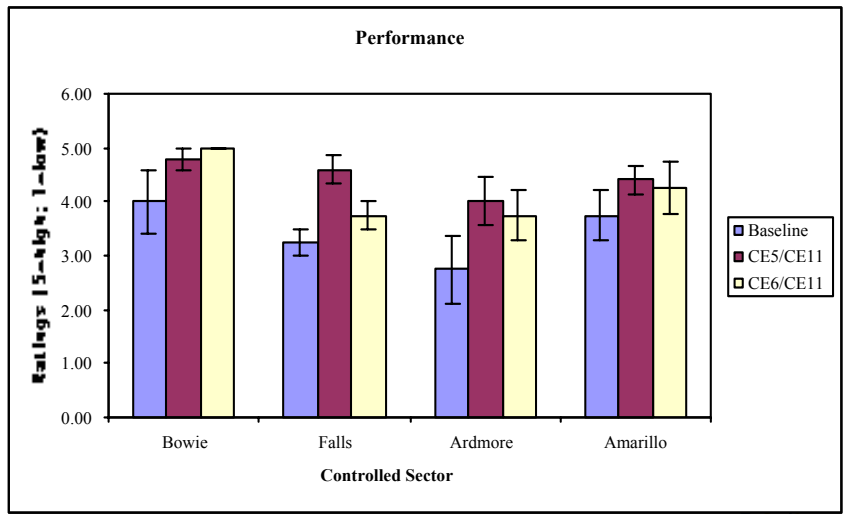
Workload: ATC Ratings









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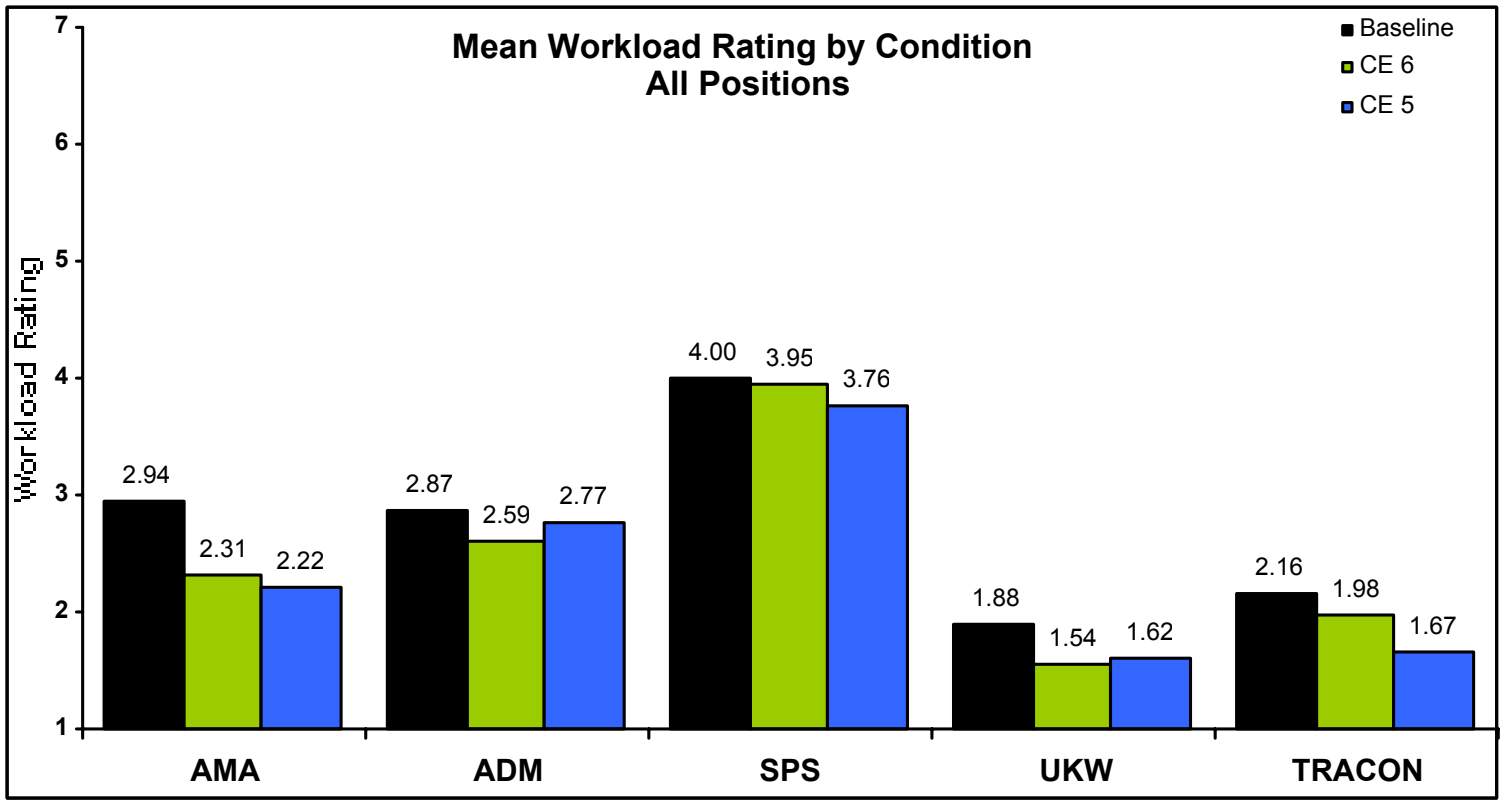
Workload: ATWIT Scores



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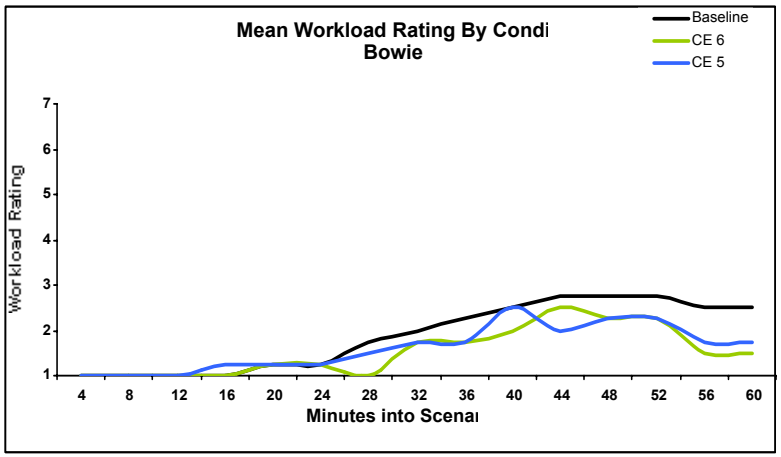

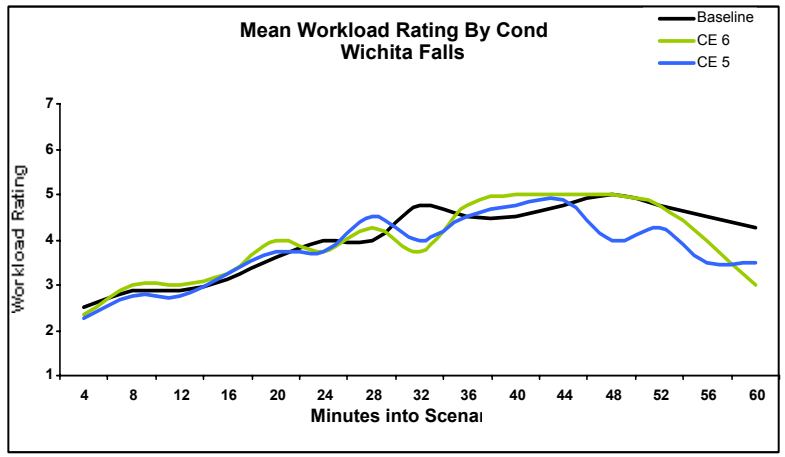

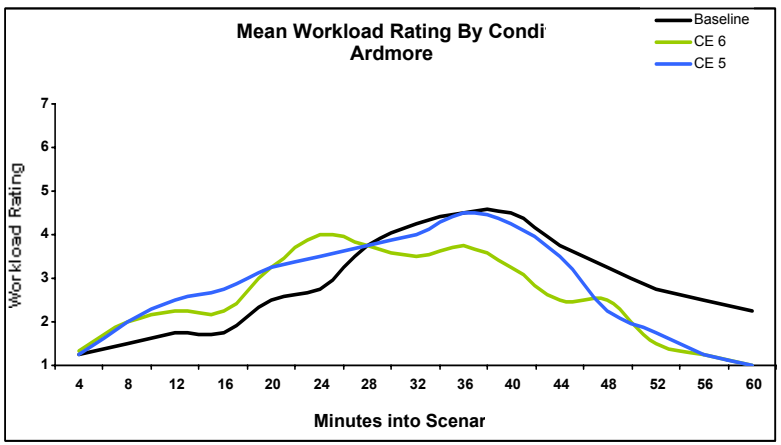

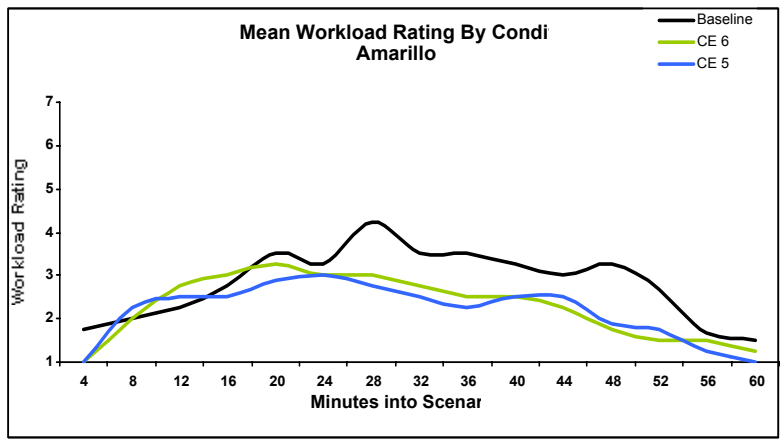

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